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EXAMINER	
BRADLEY, MATTHEW A	

ART UNIT	PAPER NUMBER
2187	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/808,561	ZOHAR ET AL.	
	Examiner	Art Unit	
	MATTHEW BRADLEY	2187	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *06 November 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *41-65,67 and 69* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *41-65,67 and 69* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

This Office Action has been issued in response to amendment filed 6 November 2009. Applicant's arguments have been carefully and fully considered but are moot in view of the new ground(s) of rejection as necessitated by amendment. Accordingly, this action has been made FINAL.

Claim Status

Claims 41-65, 67, and 69 remain pending and are ready for examination.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims **43**-**52** and **56**-**65** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Dependent claims **43**-**44**, **46**, **48**-**49**, **52**-**53**, **56**-**57**, **59**, and **61**-**62**, recite in part or make reference to 'the one or more third caches.' There is insufficient antecedent basis for this limitation in the claims. As Applicant has amended the independent claims from which the above noted dependent claims depend from, the Examiner has interpreted the language of, 'the one or more third caches' to refer to the plurality of caches as recited in the independent claims. Any claim not specifically addressed is rejected to at least by virtue of its dependency. Appropriate correction is required.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims **41**-**48**, **52**-**61**, **67**, and **69**, are rejected under 35 U.S.C. 103(a) as being unpatentable over Hicken et al. (US 2004/0153727).

As per independent claim **41**, Hicken et al. disclose a method for managing a data storage system (300 of Fig. 3; paragraph 0038, lines 4-10), comprising:

- configuring a first cache (339 of Fig. 3) to perform at least one of the operations of retrieving data from and storing data at a first range of logical addresses (LAs) in a storage device (paragraph 0038, lines 13-17; paragraph 0039, lines 7-10; paragraph 0041, lines 10-14; primary cache 333 of storage controller 370-1 is the cache for LA1, and secondary cache 339 is the redundant cache for LA1, and resides on storage controller 370-2);
- configuring a second cache (333 of Fig. 3) to perform at least one of the operations of retrieving data from and storing data at a second range of LAs and redundantly storing the data in the first range of LAs (paragraph 0039, lines 5-7; paragraph 0041, lines 10-14);
- configuring the first cache to redundantly store the data in the second range of LAs; (Paragraph 0011)

- configuring a plurality of caches (338 of Fig. 3 of Hicken [additionally as shown in Figure 9a of Nakamura and explained in more detail infra]) to perform at least one of the operations of retrieving data from and storing data at a remaining range of LAs in the storage device and redundantly storing the data in the remaining range of LAs among the plurality of caches; (paragraph 0041, lines 14-17, the Examiner notes that as the caches store data, the caches store software as instantly claimed);
- detecting that the second cache is inoperable (paragraph 0042, lines 7-9; when the storage controller 370-1 fails, cache memory 339 fails); and
- reconfiguring the plurality of caches to perform the at least one of the operations of retrieving data from and storing data at the second range of LAs in response to the inoperability while continuing to perform at least one of the operations of retrieving data from and storing data at the second range of LAs (paragraph 0044 of Hicken and additionally as shown in [Paragraph 0084, as shown in Figures 10 and 12 and further taught in Paragraphs 0101-0105 of Nakamura explained in more detail *infra*]).

Hicken does not explicitly disclose, reconfiguring the plurality of caches to redundantly store the data in the first range of LAs in response to the inoperability while continuing to perform at least one of the operations of retrieving data from and storing data at the remaining range of LAs.

Nakamura teach, reconfiguring the plurality of caches to redundantly store the data in the first range of LAs in response to the inoperability while continuing to perform

at least one of the operations of retrieving data from and storing data at the remaining range of LAs (Paragraph 0084, as shown in Figures 10 and 12 and further taught in Paragraphs 0101-0105).

Hicken and Nakamura are analogous art because they are from the same field of endeavor, namely redundant cache storage systems.

The Examiner notes that all of the component parts are known. The only difference is the combination of the known elements into one system. As Hicken teaches that the unpaired storage controllers are only used when a failure is detected amongst the paired storage controllers (Paragraph 0011), and Nakamura teaches that the redundant data in the cache pairs is stored in additional caches (Paragraph 0084), one of ordinary skill in the art at the time of invention would have been motivated to integrate the additional redundancy into Hicken as this would provide another level of reliability to the storage system of Hicken (Paragraph 0009 of Nakamura). Such combination would have yielded predictable results at the time of invention thus obviating that which is instantly claimed. Further, the Examiner notes that this additional level of redundancy would prove to be especially beneficial in the instances of sensitive data such as bank records and medical records for example.

Therefore it would have been obvious to combine Hicken with Nakamura for the additional level of redundancy to obtain the invention as specified in claims 41-48, 52-61, 67, and 69.

As per dependent claim **42**, the combination of Hicken and Nakamura, disclose the method according to claim 41, and comprising configuring one or more interfaces

(CPUs 331 and 336 of Fig. 3 of Hicken) to receive input/output (IO) requests (paragraph 0025, lines 4-6 [a distinct but almost identical embodiment]; paragraph 0039, lines 15-16 of Hicken) from host processors (310 of Fig. 3; paragraph 0038, lines 4-7) of Hicken directed to specified LAs (paragraph 0025, lines 3-6 of Hicken) and to direct all the IO requests to the caches which have been configured to perform at least one of the operations of retrieving data from and storing data at the specified LAs (paragraph 0039, lines 15-16 of Hicken).

As per dependent claim **43**, the combination of Hicken and Nakamura disclose the method according to claim 42, wherein the one or more interfaces comprise a mapping between the first and the second and the one or more third caches and the first and second ranges of the LAs (paragraph 0038, lines 13-17 of Hicken), and wherein the one or more interfaces are adapted to convert the IO requests to one or more requests and to direct the one or more requests to at least one of the first and the second and the one or more third caches in response to the mapping (paragraph 0025, lines 4-6; paragraph 0026, lines 1-2; the CPUs onboard the storage controllers receive storage requests from the host, and issue them to the caches of Hicken), and wherein detecting the inability comprises generating a reconfigured mapping between the first and the one or more third caches and the first and second ranges of the LAs (paragraph 0042, lines 9-13 of Hicken), and directing the one or more requests to at least one of the first and the one or more third caches in response to the reconfigured mapping (paragraph 0042, lines 9-13 of Hicken).

As per dependent claim **44**, the combination of Hicken and Nakamura disclose the method according to claim 41, wherein reconfiguring the at least one of the first cache and the one or more third caches comprises processing data in the first cache and the one or more third caches so as to restore the first cache and the one or more third caches to a state of full data redundancy (paragraph 0044, lines 15-24 of Hicken).

As per dependent claim **45**, the combination of Hicken and Nakamura disclose the method according to claim 44, wherein processing the data comprises classifying data in the first cache into a plurality of data groups (paragraph 0043, lines 10-15; when the caches are flushed, only the dirty data is flushed, not the resident data, which shows the data was classified of Hicken).

As per dependent claim **46**, the combination of Hicken and Nakamura disclose the method according to claim 45, wherein one of the data groups comprises dirty data, and wherein processing the data comprises storing the dirty data at the one or more third caches (paragraph 0043, lines 10-15; dirty data is stored on the third cache 338 of Hicken).

As per dependent claim **47**, the combination of Hicken and Nakamura disclose the method according to claim 45, wherein one of the data groups comprises dirty data, and wherein processing the data comprises storing the dirty data at the storage device (paragraph 0043, lines 10-15; dirty data is flushed to the storage units of Hicken).

As per dependent claim **48**, the combination of Hicken and Nakamura disclose the method according to claim 41, wherein reconfiguring the at least one of the first cache and the one or more third caches comprises retaining an initial configuration of

the first cache (paragraph 0042, lines 9-13, lines 18-22; after the second cache 333 fails, the first cache 339 retains its initial configuration and is now used to address storage requests for LA1 of Hicken).

As per dependent claim **52**, the combination of Hicken and Nakamura disclose the method according to claim 41, and comprising providing a system manager (host computer 310 and CPUs 331 and 336 of Fig. 3 of Hicken) which is adapted to configure the first, second and one or more third caches (paragraph 0025, lines 4-6; paragraph 0039, lines 15-16 of Hicken), to detect the inability (paragraph 0028, lines 1-4 of Hicken), and to reconfigure the at least one of the first cache and the one or more third caches (paragraph 0042, lines 9-13, lines 18-22 of Hicken).

As per dependent claim **53**, the combination of Hicken and Nakamura disclose the method according to claim 52, wherein providing the system manager comprises incorporating one or more manager processing units into at least one of the storage device, the first cache, the second cache, and the one or more third caches (host computer 310 and CPUs 331 and 336 of Fig. 3 of Hicken), and operating the one or more manager processing units in a cooperative manner (paragraph 0040; all of the CPUs are connected and work together of Hicken).

As per independent claim **54**, the combination of Hicken and Nakamura disclose a data storage system, comprising:

- a storage device (300 of Fig. 3; paragraph 0038, lines 4-10 of Hicken) wherein data is stored at logical addresses (LAs);

- a first cache (339 of Fig. 3 of Hicken) configured to perform at least one of the operations of retrieving data from and storing data at a first range of LAs in the storage device (paragraph 0038, lines 13-17; paragraph 0039, lines 7-10; paragraph 0041, lines 10-14; primary cache 333 of storage controller 370-1 is the cache for LA1, and secondary cache 339 is the redundant cache for LA1, and resides on storage controller 370-2 of Hicken);
- a second cache (333 of Fig. 3 of Hicken) configured to perform at least one of the operations of retrieving data from and storing data at a second range of LAs and redundantly storing the first range of LAs, the first cache further configured to redundantly store the second range of LAs (paragraph 0039, lines 5-7; paragraph 0041, lines 10-14 of Hicken);
- a plurality of remaining caches (338 of Fig. 3 of Hicken and [additionally as shown in Figure 9a of Nakamura]) configured to perform at least one of the operations of retrieving data from and storing data at a remaining range of LAs in the storage device and redundantly storing the data in the remaining range of LAs; (paragraph 0041, lines 14-17, the Examiner notes that as the caches store data, the caches store software as instantly claimed of Hicken); and
- a system manager (host computer 310 and CPUs 331 and 336 of Fig. 3 of Hicken)
    - configured to detect that the second cache is inoperable (paragraph 0042, lines 7-9; when the storage controller 370-1 fails, cache memory 339 fails as well of Hicken), and

- reconfigure the remaining plurality of caches to perform at least one of the operations of retrieving data from and storing data at the first range of LAs and redundantly storing the data in the second range of LAs in response to the inoperable detection (Paragraph 0084, as shown in Figures 10 and 12 and further taught in Paragraphs 0101-0105 of Nakamura).

As per dependent claim **55**, the combination of Hicken and Nakamura disclose the storage system according to claim 54, and comprising one or more interfaces (CPUs 331 and 336 of Fig. 3 of Hicken) which are configured to receive input/output (IO) requests (paragraph 0025, lines 4-6 [a distinct but almost identical embodiment]; paragraph 0039, lines 15-16 of Hicken) from host processors (310 of Fig. 3; paragraph 0038, lines 4-7 of Hicken) directed to specified LAs (paragraph 0025, lines 3-6 of Hicken) and to direct all the IO requests to the caches which have been configured to perform at least one of the operations of retrieving data from and storing data at the specified LAs (paragraph 0039, lines 15-16 of Hicken).

As per dependent claim **56**, the combination of Hicken and Nakamura disclose the storage system according to claim 55, wherein the one or more interfaces comprise a mapping between the first and the second and the one or more third caches and the first and second ranges of the LAs (paragraph 0038, lines 13-17 of Hicken), and wherein the one or more interfaces are adapted to convert the IO requests to one or more requests and to direct the one or more requests to at least one of the first and the second and the one or more third caches in response to the mapping (paragraph 0025, lines 4-6; paragraph 0026, lines 1-2; the CPUs onboard the storage controllers receive

storage requests from the host, and issue them to the caches of Hicken), and wherein detecting the inability comprises the system manager generating a reconfigured mapping between the first and the one or more third caches and the first and second ranges of the LAs (paragraph 0042, lines 9-13 of Hicken), and directing the one or more requests to at least one of the first and the one or more third caches in response to the reconfigured mapping (paragraph 0042, lines 9-13 of Hicken).

As per dependent claim **57**, the combination of Hicken and Nakamura disclose the storage system according to claim 54, wherein reconfiguring the at least one of the first cache and the one or more third caches comprises the first cache processing data therein and the one or more third caches processing data therein so as to restore the first cache and the one or more third caches to a state of full data redundancy (paragraph 0044, lines 15-24 of Hicken).

As per dependent claim **58**, the combination of Hicken and Nakamura disclose the storage system according to claim 57, wherein processing the data comprises classifying data in the first cache into a plurality of data groups (paragraph 0043, lines 10-15; when the caches are flushed, only the dirty data is flushed, not the resident data, which shows the data was classified of Hicken).

As per dependent claim **59**, the combination of Hicken and Nakamura disclose the storage system according to claim 58, wherein one of the data groups comprises dirty data, and wherein processing the data comprises storing the dirty data at the one or more third caches (paragraph 0043, lines 10-15; dirty data is stored on the third cache 338 of Hicken).

As per dependent claim **60**, the combination of Hicken and Nakamura disclose the storage system according to claim 58, wherein one of the data groups comprises dirty data, and wherein processing the data comprises storing the dirty data at the storage device (paragraph 0043, lines 10-15; dirty data is flushed to the storage units of Hicken).

As per dependent claim **61**, the combination of Hicken and Nakamura disclose the storage system according to claim 54, wherein reconfiguring the at least one of the first cache and the one or more third caches comprises retaining an initial configuration of the first cache (paragraph 0042, lines 9-13, lines 18-22; after the second cache 333 fails, the first cache 339 retains its initial configuration and is now used to address storage requests for LA1 of Hicken).

As per dependent claim **67**, the combination of Hicken and Nakamura disclose, wherein the mass storage devices comprise one or more disks (Figure 1 paragraph 0022 of Hicken).

As per dependent claim **69**, the combination of Hicken and Nakamura disclose, wherein the mass storage devices comprise one or more disks (Figure 1 paragraph 0022 of Hicken).

Claims **49-51** and **62-65** are rejected under 35 U.S.C. 103(a) as being unpatentable over Hicken, in view of Nakamura, and further in view of Karger et al. ("Consistent Hashing and Random Trees: Distributed Caching Protocols for Relieving Hot Spots on the World Wide Web," by in the Proceedings of the 29th ACM Symposium on Theory of Computing, Pages 654-663), hereinafter referred to as Karger.

As per dependent claim **49**, the combination of Hicken and Nakamura disclose the method according to claim 41.

The combination of Hicken and Nakamura do not disclose the limitation wherein reconfiguring the at least one of the first cache and the one or more third caches comprises implementing a minimum redistribution of the first and the second ranges among the first cache and the one or more third caches.

Karger et al. disclose the limitation wherein reconfiguring the at least one of the first cache and the one or more third caches comprises implementing a minimum redistribution of the first and the second ranges among the first cache and the one or more third caches (page 5, section 4, "Consistent Hashing").

The combination of Hicken and Nakamura and Karger are analogous art because they are from the same field of endeavor, namely data caching.

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the minimum redistribution in the form of consistent hashing of Karger with the data caching redundancy system of Hicken and Nakamura. The motivation for doing so would have been because to prevent requiring a central server to distribute a completely updated hash table to all the machines every time a new machine is added to the network (page 2, column 2, paragraph 2 beginning with "Our second…").

Therefore, it would have been obvious to a person of ordinary skill in the art to combine Karger with Hicken and Nakamura. for the benefit of a data caching system with consistent hashing to obtain the invention as specified in claims 49-51 and 62-65.

As per dependent claim **50**, the combination of Hicken, Nakamura, and Karger disclose the limitation wherein implementing the minimum redistribution comprises redistributing the first and the second ranges using a consistent hashing function (page 5, section 4, "Consistent Hashing" of Karger).

As per dependent claim **51**, the combination of Hicken, Nakamura, and Karger disclose the limitation wherein redistribution comprises redistributing the first and the second ranges using a random number function (page 2, column 1, paragraph 5, "Our first tool, *random cache trees*…" of Karger).

As per dependent claim **62**, the combination of Hicken, Nakamura, and Karger disclose the limitation wherein reconfiguring the at least one of the first cache and the one or more third caches comprises the system manager implementing a minimum redistribution of the first and the second ranges among the first cache and the one or more third caches (page 5, section 4, "Consistent Hashing" of Karger).

As per dependent claim **63**, the combination of Hicken, Nakamura, and Karger disclose the limitation wherein implementing the minimum redistribution comprises redistributing the first and the second ranges using a consistent hashing function (page 5, section 4, "Consistent Hashing" of Karger).

As per dependent claim **64**, the combination of Hicken, Nakamura, and Karger disclose the limitation wherein redistribution comprises redistributing the first and the second ranges using a random number function (page 2, column 1, paragraph 5, "Our first tool, *random cache trees*…" of Karger).

As per dependent claim **65**, the combination of Hicken, Nakamura, and Karger disclose the storage system according to claim 64 wherein the system manager comprises one or more manager processing units incorporating one or more manager processing units into at least one of the storage device, the first cache, the second cache, and the one or more third caches (host computer 310 and CPUs 331 and 336 of Fig. 3 of Hicken), and wherein the one or more manager processing units operate in a cooperative manner (paragraph 0040; all of the CPUs are connected and work together of Hicken).

Response to Arguments

Applicant's arguments filed 6 November 2009 have been carefully and fully considered but are moot in view of the new ground(s) of rejection as necessitated by amendment.

With respect to Applicant's argument located under the subheadings of II and III which are drawn to Hicken's alleged failure to teach the claimed elements of:

> "reconfiguring the plurality of caches to perform the at least one of the operations of retrieving data from and storing data at the second range of LAs in response to the inoperability while continuing to perform at least one of the operations of retrieving data from and storing data at the remaining range of LAs" and "reconfiguring the plurality of caches to redundantly store the data in the first range of LAs in response to the inoperability while continuing to perform at least one of the operations of retrieving data from and storing data at the remaining range of LAs".

The Examiner respectfully refers Applicant's to the rejection made *supra* which incorporates Nakamura to teach Hicken's deficiency.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew Bradley whose telephone number is (571) 272-8575. The examiner can normally be reached on 6:30-3:00 M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Christian Chace can be reached on (571) 272-4190. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

CPC/mb

/Christian P. Chace/

Supervisory Patent Examiner, Art Unit 2187